

WHAT IS CLAIMED IS:

- 1 1. A method of depositing a silica glass insulating film over a
2 substrate, the method comprising:
3 exposing the substrate to a silicon-containing reactant introduced into a
4 chamber in which the substrate is disposed such that one or more layers of the silicon-
5 containing reactant are adsorbed onto the substrate;
6 purging or evacuating the chamber of the silicon-containing reactant;
7 converting the silicon-containing reactant into a silica glass insulating
8 compound by exposing the substrate to oxygen radicals formed from a second reactant
9 while biasing the substrate to promote a sputtering effect; and
10 repeating the exposing, purging/evacuating and exposing sequence a
11 plurality of times.
- 1 2. The method of claim 1 wherein an average atomic mass of all
2 atomic constituents in the second reactant is less than or equal to an average atomic
3 mass of oxygen.
- 1 3. The method of claim 1 wherein the silicon-containing reactant is
2 a silane family member having a formula of $\text{Si}_n\text{H}_{2n+2}$.
- 1 4. The method of claim 3 wherein the second reactant consists of
2 molecular oxygen (O_2).
- 1 5. The method of claim 1 wherein the second reactant consists of
2 molecular oxygen (O_2) and a sputtering agent.
- 1 6. The method of claim 5 wherein the sputtering agent consists of
2 molecular hydrogen (H_2).
- 1 7. The method of claim 5 wherein the light weight sputtering agent
2 comprises molecular hydrogen (H_2) and/or helium.
- 1 8. The method of claim 1 wherein the oxygen radicals are generated
2 by forming a plasma within the chamber.

1 9. The method of claim 1 wherein the oxygen radicals are generated
2 by forming a plasma in a remote plasma chamber.

1 10. The method of claim 1 wherein the chamber is evacuated of the
2 silicon-containing reactant prior to exposing the substrate to oxygen radicals.

1 11. The method of claim 1 wherein the chamber is purged of the
2 silicon-containing reactant by flowing a gas that is chemically inert to silica glass into
3 the chamber.

1 12. The method of claim 1 wherein the chamber is purged of the
2 silicon-containing reactant by flowing an oxygen source into the chamber.

1 13. The method of claim 8 wherein energy is applied to the chamber
2 to form a plasma from the second reactant while biasing the substrate and wherein no
3 plasma is formed while the substrate is exposed to the silicon-containing reactant.

1 14. The method of claim 1 further comprising doping the silica glass
2 film with a dopant.

1 15. A method of depositing a silica glass insulating film over a
2 substrate having a gap formed between two adjacent raised features, the gap having a
3 bottom surface and a sidewall surface, the method comprising:
4 exposing the substrate to a silicon-containing reactant introduced into a
5 chamber in which the substrate is disposed such that one or more layers of the
6 silicon-containing reactant are adsorbed onto the substrate;
7 purging or evacuating the chamber of the silicon-containing reactant;
8 converting the silicon-containing reactant into a silica glass insulating
9 compound by exposing the substrate to a plasma formed from a second reactant
10 comprising oxygen atoms while biasing the substrate to promote a sputtering effect,
11 wherein an average atomic mass of all atomic constituents in the second reactant is less
12 than or equal to an average atomic mass of oxygen; and
13 repeating the exposing, purging/evacuating and exposing sequence a
14 plurality of times;

15 wherein the substrate is maintained at a temperature between 300-800°C
16 during growth of the silica glass film and wherein the silica glass film grows up from
17 the bottom surface of the gap at a rate greater than it grows inward on the sidewall
18 surface of the gap.